Request to Archive
With The National Centers for Environmental Information
For Total Solar Irradiance (TSI) and Solar Spectral Irradiance (SSI) CDR, Version 2.1
Provided by University of Colorado, LASP

2016-11-29

This information will be used by NCEI to conduct an appraisal and make a decision on the request.

1. Who is the primary point of contact for this request?

Odele Coddington
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2. Name the organization or group responsible for creating the dataset.

LASP (Odele Coddington, Peter Pilewskie, and Marty Snow) & Naval Research Laboratory (Judith Lean)

3. Provide an overview summarizing the scope of data you want to archive. Describe the outputs, data variables, including their measurement resolution and coverage.

The Total Solar Irradiance (TSI) and Solar Spectral Irradiance (SSI) FCDR provide daily values of the TSI and the concurrent (self consistent) SSI on multiple time scales, from days to centuries, in wavelength bands designed to be suitable for use in climate and atmosphere models. A composite observational record of daily TSI is constructed by cross calibrating extant observations from 1978 to the present. Historical time series are calculated using the NRL-developed models. Provided are daily and monthly TSI and SSI from 1882 to the present, and annual TSI and SSI since 1615. The data set covers, in aggregate, the period from the beginning of the acceptable historical index record to the last achievable processing period prior to the CDR delivery date. The data sets will be delivered to NCDC in netCDF4 file format following CF metadata conventions. The FCDR delivery will conform to CDRP requirements for source code, data and metadata, and utilize a data delivery mechanism to be agreed upon in a CDR Submission Agreement.
One additional file will contain reference solar spectra:representative quiet, minimum and maximum conditions and a Maunder minimum spectrum

4. What is the time period covered by the dataset? (YYYY-MM-DD, YYYY-MM or YYYY)

From 1610
Ongoing as continuous updates to the data record

5. Edition or version number(s) of the dataset:

Version 2, Revision 1

6. Approximate date when the dataset was or will be released to the public:

2017-01-01

7. Who are the expected users of the archived data? How will the archived data be used?

Industry - renewable energy, water resources, hydrology, atmospheric chemistry and applications, photocell and solar energy applications

Science Communities - Global Climate Model (GCM) groups, atmospheric chemistry assimilation models (autochem), stratospheric and stratospheric/climate models, Community Radiative Transfer Models (MODTRAN)
Federal and State Government - NASA (Earth Science and Heliophysics Divisions), NOAA, NRL, NREL, NIST

8. Has the dataset undergone user evaluation and/or an independent review process? Did NCEI participate in design reviews?

The technical aspects of the composite construction and model formulation have been published in multiple peerreviewed
journal papers. The corresponding models, designated NRLTSI and NRLSSI, have been used as inputs for many climate and atmospheric model simulations, including IPCC AR4 and AR5 (e.g., Schmidt et al. 2011). The NRLTSI2 and NRLSSI2 models, which were transitioned in 2015, are revised versions of the NRLTSI model, which is
based on a composite record of TSI from 1978 to 2003 (Fröhlich and Lean 2004) and the NRLSSI model, which is based
on UARS UV (120 to 400 nm) spectral irradiance observations from 1992 to 1994 (Lean et al. 1997). Theoretical estimates of wavelength-dependent sunspot and facular contrast functions are used in the region 400 100000 nm (Lean 2000, Lean et al. 2005). Lean (2000) describes the various indices available for use in irradiance variability models. Initially, the long-term irradiance changes were estimated from the variability of Sun-like stars
(Lean, White and Skumanich 1995; Lean, Beer and Bradley 1995) then subsequently revised following flux transport model calculations of the evolution of magnetic flux with solar activity (Wang et al. 2005). Lean and Woods (2010) provide an overview of the NRL solar irradiance variability models, and Thuillier et al. (2013) compare NRLSSI with other spectral irradiance variability models. The NRLTSI2 and NRLSSI2 models are the next versions of these models,
and incorporate new understanding of solar irradiance afforded by the SORCE/TIM and SORCE/SIM observations. The NRLTSI2 and NRLSSI2 model output, ancillary datasets, and accompanying documentation form the Solar Irradiance Climate Data Record (CDR). Coddington et al., (2015) describe the model formulation of NRLTSI2 and NRLSSI2 and make comparisons to the original model version and to measurements.

9. Describe the dataset's relationship to other archived datasets, such as earlier versions or related source data. If this is a new version, how does it improve upon the previous version(s)?

v02r01 improves the scientific quality of the earlier version, v02r00, based on new research in two avenues to reach high accuracy and improved understanding of uncertainties with the Solar Irradiance CDR.
First, a regression analysis of our proxy input of sunspot darkening with an independent proxy of solar activity suggests
there is reason to support changing the scaling offset between the USAF SOON sunspot area record with respect to the Royal Greenwich Observatory (RGO) sunspot area records, which varies from 20%-50% in the literature.
Second, The Sunspot Index and Long-term Solar Observations (SILSO) center released a revised version of the sunspot
number record. Their revised record extends back to 1610 as did the original Hoyt and Schatten record. We use the sunspot number record in the solar irradiance CDR as the sole proxy of solar activity from 1610 to 1882. The science community would be interested in the Solar Irradiance CDR record for the historical time period derived from the original Hoyt and Schatten and the new SILSO sunspot number records.
Third, in v02r01, we add the magnitude of speculative, secular, long-term facular component of the irradiance variability
to the daily and monthly-averaged TSI and SSI uncertainty estimates derived from solar cycle activity. In v02r00 version
of the CDR, this component was only included in the uncertainty estimates of the yearly-averaged TSI and SSI irradiances.

Fourth, a TSI observational composite delivered as part of the Solar Irradiance CDR will be updated for v02r01 to include
a 3rd observational composite from Royal Meteorlogical Institute of Belgium (RMIB) in addition to the ACRIM and PMOD composites, prior to the SORCE TIM epoch.

10. List the input datasets and ancillary information used to produce the data.

-Mg II Index: SORCE Solstice, GOME (Univ. Bremen), GOME2 (Univ. Bremen)
-USAF White Light: Sunspot Regions Obtained from NOAA/NGDC-Bill Denig
-Royal Greenwich Observatory (RGO) sunspot area records.
- Original composite sunspot number record (Hoyt and Schatten, 1998).
-Revised Sunspot Index and Long-term Solar Observations (SILSO) center sunspot number record (Clette et al., 2013)
-Fixed scaling coefficients to convert the input Mg II index to the scale of the NOAA Mg II index com

11. List web pages and other links that provide information on the data.

NOAA NCEI is the definitive source for the Solar Irradiance CDR.
https://www.ncdc.noaa.gov/cdr/atmospheric/total-solar-irradiance
https://www.ncdc.noaa.gov/cdr/atmospheric/solar-spectral-irradiance
The Laboratory for Atmospheric and Space Physics (LASP) also serves the Solar IRradiance CDR. Since the SSI uncertainties are not delivered to NOAA NCEI due to file size considerations, SSI uncertainties (in netcdf4 format) are only available from the LASP Interactive Solar IRradiance Datacenter (LISIRD) server.
http://lasp.colorado.edu/lisird3/data/nrl2_files
http://lasp.colorado.edu/lisird3/data/nrl2_ssi_P1D/
http://lasp.colorado.edu/lisird3/data/nrl2_ssi_P1M/
hhttp://lasp.colorado.edu/lisird3/data/nrl2_ssi_P1D/
http://lasp.colorado.edu/lisird3/data/nrl2_tsi_P1M/
http://lasp.colorado.edu/lisird3/data/nrl2_tsi_P1Y/
http://lasp.colorado.edu/lisird3/data/nrl2_tsi_P1Y/

12. List the kinds of documents, metadata and code that are available for archiving. For example, data format specifications, user guides, algorithm documentation, metadata compliant with a standard such as ISO 19115, source code, platform/instrument metadata, data/process flow diagrams, etc.

1. Solar Irradiance CDR Implementation Plan
2. Solar Irradiance Data Flow Diagram
3. Maturity Matrix
4. Algorithm Theoretical Basis Document (Delivered; will be updated for v02r01 release)

13. Indicate the data file format(s).

1. netCDF-4

14. Are the data files compressed?

No

15. Provide details on how the files are named and how they are organized (e.g., file_name_pattern_YYYYMM.tar in monthly aggregations).

File naming convention: [data-short-name]_[data-version]_[extra-attribute(s)]_s[begin-date]_e[end-date]_c[file-date].[extension]
In v02r01, the yearly-averaged TSI and SSI that is delivered in a single period of record (from 1610 to present day), will be separated into two, unique, datasets to reflect differences due to the composite sunspot number record based on

original Hoyt and Schatten (1998) or revised SILSO record (Clette et al., 2013). The diffferent sunspot number records affect estimated TSI and SSI between 1610 and 1882.
Example naming conventions:
tsi_v02r01_daily_s20150101_e20151231_c20160225.nc
tsi_v02r01_monthly_s201501_e201512_c20160225.nc
tsi_v02r01_yearly_s1610_e2015_c20160229.nc (*need to revise to indicate sunspot number source)
ssi_v02r01_daily_s20150101_e20151231_c20160225.nc
ssi_v02r01_monthly_s201501_e201512_c20160225.nc
ssi_v02r01_yearly_s1610_e2015_c20160229.nc (*need to revise to indicate sunspot number source)
The ancillary datasets (model input time series and TSI observational composite) will be updated on a quarterly cadence, in a single period of record file that extends and replaces previously delivered files.
tsi-ssi_v02r01_model-input-time-series_s18820101_e20160630_c20160727.txt
observed-tsi-composite_s19780101_e20160630_c20160727.txt
A one-time delivery (no update cadence) of SSI reference spectra of quiet Sun, low, moderate, and high solar activity - and a Maunder minimum spectrum - will also be delivered. Example naming convention:
tsi-ssi_v02r01_reference-spectra_c20151019.txt

16. Explain how to access sample data files and/or a file listing for previewing. If it is not available now, when will it be available?

Sample netCDF data will be provided by Dec 2, 2016 for CF metadata review check

17. What is the total data volume to be submitted?

Historic Data: all historic data or data submitted as a completed collection.

Total Data Volume:	9.6GB
Number of Data Files:	544

Continuous Data: data volume rate for a continuous data production.

Total Data Volume Rate:	5.36MB per Year
Data File Frequency:	6 per Month
Data Production Start:	2017-01-01

18. Are later updates, revisions or replacement files anticipated? If so, explain the conditions for submitting these additional data to the archive.

The updates to regression coefficients, which are constant in a given model version, will be infrequent (every several years at most); the update will reflect new understanding of solar irradiance variability obtained from the observations as the record continues to length in time.

19. Describe the server that will connect to the ingest server at NCEI for submitting the data.

Physical Location:	Laboratory for Atmospheric and Space Physics, Boulder, CO, 80303
System Name:	LISIRD/LaTiS
System Owner:	UCO/LASP > Laboratory for Atmospheric and Space Physics, University of Colorado
Additional Information:	We would initiate the sftp put from LASP.

20. What are the possible methods for submitting the data to NCEI? Select all that apply.

1. FTP PUSH

2. SFTP PUSH
HTTP service request

21. Identify how you would like NCEI to distribute the data. Web access support depends on the resources available for the dataset.
1. Direct download links
2. Advanced web services (e.g., THREDDS Catalog Service)

22. Will there be any distribution, usage, or other restrictions that apply to the data in the archive?
No known constraints apply to the data.

23. Discuss the rationale for archiving the dataset and the anticipated benefits. Mention any risks associated with not archiving the dataset at NCEI.
Dataset(s) are supported by the NOAA CDR Program

24. Are the data archived at another facility or are there plans to do so? Please explain.
The data are also archived at the Laboratory for Atmospheric and Space Physics (LASP) and are distributed through the LASP Interactive Solar Irradiance Data Center (LISIRD).

25. Is there an existing agreement or requirement driving this request to archive? Have you already contacted someone at NCEI?
Per CDR Program. See Coddington, Lean and Pilewskie SOWs.

26. Do you have a data management plan for your data?
We follow the data management plan defined by the Climate Data Record program and use CF conventions for metadata.

27. Have funds been allocated to archive the data at NCEI?
NOAA CDR Program funds.

28. Identify the affiliated research project, its sponsor, and any project/grant ID as applicable.
N/A

29. Is there a desired deadline for NCEI to archive and provide access to the data?
Archive by: 2017-01-01
Accessible by:

30. Add any other pertinent information for this request.
The data sets cover these listed time periods:
1610 to present, annually
1882-01 to present, monthly
1882-01-01 to present, daily
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Files of solar spectra to the end of 2016 will be provided as part of the initial transition. Additional files will be generated as continuous updates to the data record become available.
The file sizes are currently estimates based on the following formula:
A 1-year file containing daily values of SSI is 6.3 MB. A 1 year file containing monthly-averaged values of SSI is 0.25 MB. A single, period of record file containing yearly-averaged SSI is approximately 30 MB.

A 1-year file containing daily values of TSI is 0.3 MB. A 1 year file containing monthly-averaged values of TSI is 0.02 MB. A single, period of record file containing yearly-averaged SSI is approximately 7.5 MB.
There will be quarterly updates of this data beginning 1 Jan 2017 (i.e. first quarter of 2017 (Jan-March) is delivered in mid-April 2017)